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(71)Applicant : CANON INC

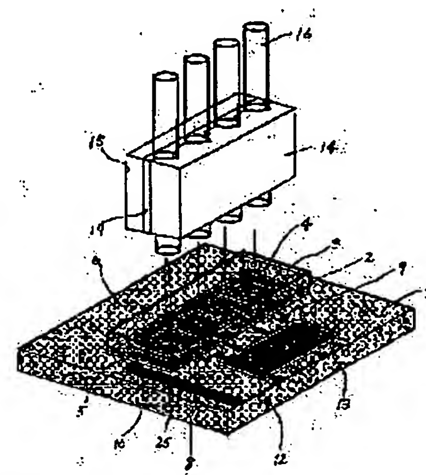
(72)Inventor : ONOUCHI TOSHIHIKO
HIROSE FUTOSHI

(54) SURFACE EMITTING OPTICAL ELEMENT, SURFACE EMITTING OPTICAL ELEMENT MOUNT, ITS MANUFACTURING METHOD AND OPTICAL WIRING DEVICE USING THE SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a surface emitting optical element at a low cost by improving productivity by facilitating a fixing work of an optical waveguide without necessity of increasing the number of components and improving process controllability.

SOLUTION: The surface emitting optical element 5 comprises a guide hole 4 formed on a surface of the element 5 to insert and fix the optical waveguide 16 capable of optically coupling to the element 5. In the element 5, the hole 4 is formed of a thick film material 3 selectively curable by patterning the hole by a photolithography having photosensitivity or electron beam curability.



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CLAIMS

[Claim(s)]

[Claim 1] The two-dimensional light corpuscle child who is a two-dimensional light corpuscle child in whom luminescence or light-receiving is possible, and is characterized by having formed alternatively with the thick-film ingredient which can be hardened by having optical photosensitivity or electron beam hardenability in this two-dimensional light corpuscle child's front face, and carrying out patterning of the guide hole for inserting and fixing an optical guided wave object so that optical coupling with this two-dimensional light corpuscle child may be possible with phot lithography.

[Claim 2] Said thick-film ingredient is a two-dimensional light corpuscle child according to claim 1 who is the thick-film resist in which polymer-izing is possible.

[Claim 3] The thickness of said thick-film ingredient or a thick-film resist is a two-dimensional light corpuscle child according to claim 1 or 2 who is 10 micrometers to 1000 micrometers.

[Claim 4] The 1st layer in which the hole where said thick-film ingredient or a thick-film resist can penetrate only light smaller than the size of said optical guided wave object was formed, The two-dimensional light corpuscle child according to claim 1, 2, or 3 who consisted of the 2nd layer in which the guide hole for being formed on this 1st layer and fixing this optical guided wave object was formed, and has specified the distance of the end face of said two-dimensional light corpuscle child and this optical guided wave object by the thickness of the 1st layer.

[Claim 5] The guide hole formed by said thick-film ingredient or the thick-film resist is a two-dimensional light corpuscle child given in claim 1 thru/or any of 4 they are. [which forms only the part doubled with the appearance of this optical guided wave object]

[Claim 6] The guide hole formed by said thick-film ingredient or the thick-film resist is a two-dimensional light corpuscle child given in claim 1 thru/or any of 4 they are. [which also forms the slot pattern with which the appearances differ with the part doubled with the appearance of this optical guided wave object]

[Claim 7] The part doubled with the appearance of the optical guided wave object of said guide hole and a slot pattern are a two-dimensional light corpuscle child according to claim 6 currently formed continuously.

[Claim 8] Said two-dimensional light corpuscle child is a two-dimensional light corpuscle child given in claim 1 thru/or any of 7 they are. [which is formed by forming two or more arrays and array-izing both guide holes corresponding to it]

[Claim 9] Said two or more two-dimensional light corpuscle children are two-dimensional light corpuscle children according to claim 8 only whose two-dimensional light emitting device is the combination of a two-dimensional photo detector or a two-dimensional light emitting device, and a two-dimensional photo detector.

[Claim 10] Said two-dimensional light corpuscle child is a two-dimensional light corpuscle child given in claim 1 thru/or any of 9 they are. [which is the surface emission-type lasers of a perpendicular resonator mold]

[Claim 11] Said surface emission-type laser is a two-dimensional light corpuscle child according to claim 10 to whom the stratum functionale of only a barrier layer, a resonator layer, and a Bragg reflection

mirror layer is left behind.
[Claim 12] Said two-dimensional light corpuscle child is a two-dimensional light corpuscle child given [a growth substrate] in any [removal or claim 1 which thin-film-izes and has become a thin film mold thru/or] of 10 they are.
[Claim 13] Said two-dimensional light corpuscle child is a two-dimensional light corpuscle child given in claim 1 thru/or any of 10 they are. [to which the growth substrate is left behind as it is]
[Claim 14] The two-dimensional light corpuscle child mounting object characterized by having electrical installation and a two-dimensional light corpuscle child according to claim 1 to 13 being mounted in a mounting substrate so that it can drive, and fixing an optical guided wave object to said guide hole, and growing into it.
[Claim 15] Said mounting substrate is a two-dimensional light corpuscle child mounting object according to claim 14 which is the mounting substrate which can accumulate other light corpuscle children or electronic devices on a hybrid, and has a heat sink function.
[Claim 16] The two-dimensional light corpuscle child mounting object according to claim 14 or 15 which said two-dimensional light corpuscle child is formed into two or more arrays, and comes [array]-izing [an optical guided wave object / coincidence].
[Claim 17] Said optical guided wave object is a two-dimensional light corpuscle child mounting object according to claim 14, 15, or 16 which consists of optical fibers containing a polymer.
[Claim 18] Said optical guided wave object is a two-dimensional light corpuscle child mounting object according to claim 14, 15, or 16 which consists of optical fibers containing a quartz.
[Claim 19] In the approach of producing a two-dimensional light corpuscle child mounting object given in any [claim 14 thru/or] of 18 they are The process and at least one two-dimensional light corpuscle child who form a circuit pattern in a wafer-like mounting substrate serially The process mounted in two or more places of a mounting substrate, the process which forms a guide hole with a thick-film ingredient on each two-dimensional light corpuscle child, The production approach of the two-dimensional light corpuscle child mounting object characterized by including the process started on the mounting object of magnitude required after carrying out flip chip mounting of the required electron device etc. serially in a required location, and the process which fits an optical guided wave object over a guide hole, and is fixed at the last. [two or more]
[Claim 20] The optical wiring equipment characterized by to mount through a connection lead in the board in electronic equipment, to also integrate the electronic circuitry for a two-dimensional light corpuscle child drive on a two-dimensional light corpuscle child mounting object given in whether any [claim 14 thru/or] of 18 they are, to mount this optical mounting object in the plinth which fixes the connection lead for acquiring electric contact in the optical wiring equipment which delivers and receives the signal between boards with light, and to constitute an optical connection module.
[Claim 21] Optical wiring equipment characterized by mounting a two-dimensional light corpuscle child mounting object given in any [claim 14 thru/or] of 18 they are on the electronic circuitry for a two-dimensional light corpuscle child drive, storing in an electrical connector, and for the contact pin for connectors in which desorption is possible performing electrical connection to this electronic circuitry for a drive, and delivering and receiving an electronic equipment comrade's signal with light.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the optical mounting object which combined optically the two-dimensional light corpuscle child and two-dimensional light corpuscle child who can combine optical guided wave objects, such as an optical fiber, optically, and the optical guided wave object by low cost, its production approach, and the optical wiring equipment using it.
[0002]
[Description of the Prior Art] In recent years, the optical module for high-speed light connection is developed. However, there are many technical problems from viewpoints, such as low-cost-izing and high-performance-izing, especially concerning association with a light corpuscle child and optical transmission objects, such as an optical fiber.
[0003] Although the component two-dimensional at points, such as the ease of production and sensibility, is mainly used by the photo detector as a light corpuscle child, when carrying out optical coupling by the optical fiber and the principal plane of this two-dimensional component, it is indispensable in order for the passive alignment which carries out alignment without operating a photo detector to be low cost-ization. The method of generally producing and assembling a holddown member as technique for that is used. However, since the machine precision of a holddown member was required, and the elastic modulus, coefficient of thermal expansion, etc. had constraint and components mark also increased, cost reduction was difficult. When plastic mold etc. is especially used for cost reduction, there is a trouble that dependability is missing the yield of optical coupling and over a long period of time.
[0004] Also in the light emitting device, the perpendicular resonator mold face luminescence laser which performs optical outgoing radiation perpendicularly from a substrate side may be able to improve in the viewpoint of low-power-izing of an optical transmission module, and low-cost-izing, and is studied briskly. In this surface emission-type laser, it can drive with the low threshold of 1mA or less, and inspection of wafer level is possible, and since cleavage precision is not needed, low-cost-izing is possible. The same problem as the above has arisen also in the optical coupling of such a field luminescence laser and an optical fiber.
[0005] Then, the approach of producing the guide hole for association with an optical fiber in the precision of phot lithography is proposed. For example, in JP,8-111559,A, as shown in drawing 11 , what forms the hole for fixing an optical fiber 1037 to the substrate 1021 side which produced the two-dimensional photo detector or the light emitting device by etching is indicated. in addition, drawing 11 -- setting -- 1022 -- a light absorption layer, and 1023 and 1027 -- as for SiO two-layer, and 1033 and 1035, for a barrier layer and 1028, a contact layer and 1032 are [a DBR mirror, and 1024 and 1026 / a cladding layer and 1025 / an electrode and 1036] antireflection films.
[0006] Moreover, the approach of forming also in JP,6-237016,A the guide hole 1209 which etched the substrate into the rear-face side of a surface emission-type laser 1203, and fixing an optical fiber 1210 to it, as shown in drawing 12 is indicated. Components mark can be decreased in these cases, and since an assembly is also very easy, low-cost-izing is possible. In addition, for a luminescence chip and 1204, as for a transistor electrode and 1208, in drawing 12 , a transistor, 1205, and 1206 and 1207 are [1201 / an electronic-circuitry substrate and 1202 / an insulating layer and 1211] adhesives.
[0007] However, there was a possibility of degrading a component by the approach of making a hole in a substrate since a damage goes into a crystal when control of distance with an optical fiber, a light

sensing portion, or a light-emitting part is difficult and a fiber is dashed against a crystal. So, in invention of JP,6-237016,A, the path at the tip of a guide hole was made small like, and approaches, such as stopping etching in (R> drawing 12 2 reference) and the condition of having left the substrate slightly, without etching to an epilayer, to which a forward tapered shape configuration is given to the guide hole 1209, and a fiber does not contact the crystal face, were used completely.

[0008] On the other hand, the member for fiber immobilization is directly fixed to the front-face side in which the two-dimensional light corpuscle child was formed, and the method of mounting an optical fiber is also proposed. For example, in JP,11-307869,A, as shown in drawing 13 , the projections 2022 and 2023 for carrying out fitting of the fiber holddown member 2014 are formed in the front face of the surface emission-type laser component 2018, and what constituted the guide hole in the location corresponding to the light-emitting part of a surface emission-type laser 2018 is indicated. In addition, for 2012, as for an optical fiber and 2024, in drawing 13 , a fiber insertion hole, and 2026 and 2027 are [a module substrate and 2016] guide holes.

[0009]

[Problem(s) to be Solved by the Invention] However, since the depth was usually set to 100 micrometers or more when producing a guide hole by etching, it was difficult for there to be a problem in the controllability of a taper configuration or a bore diameter, and to raise the yield. Moreover, when leaving a substrate, there was a problem of the absorption of light in a substrate, and the wavelength range which can be used had a limit.

[0010] On the other hand, in the case where the block for optical fiber immobilization is used, although the problem on the above production was not produced, in order that components mark and its processing process might increase, low cost-ization was not necessarily completed.

[0011] In view of such a technical problem, the purpose of this invention forms the guide hole which fixes optical guided wave objects, such as an optical fiber. The alignment precision of an optical guided wave object and a two-dimensional light corpuscle child is raised without needing the increment in components mark, and improvement in process control nature. It is in offering the structure which immobilization of an optical guided wave object is made easy, and productivity is raised, and attains low cost-ization, can set up freely the distance between a two-dimensional light corpuscle child and an optical guided wave object further, and raises the ease of mounting, and a degree of freedom from this. Furthermore, it is in offering the production approach which can mass-produce the structure with being such for mounting, the optical mounting object in which low-cost-izing is possible, and the optical wiring equipment using this.

[0012]

[Means for Solving the Problem and its Function] In the two-dimensional light corpuscle child of this invention, on a two-dimensional light corpuscle child's front face, it is making the structure used as the guide hole for inserting optical guided wave objects, such as a fiber, with direct phot lithography, and the above-mentioned technical problem is solved with a thick-film ingredient. That is, the two-dimensional light corpuscle child in whom luminescence or light-receiving of this invention is possible is characterized by having formed alternatively with the thick-film ingredients (thick-film resist in which polymer-izing is possible) which can be hardened by have optical photosensitivity or electron beam hardenability in this two-dimensional light corpuscle child's front face, and carry out patterning of the guide hole for insert and fix an optical guided wave object so that optical coupling with this two-dimensional light corpuscle child may be possible with phot lithography.

[0013] As thickness of said thick-film ingredient thru/or a thick-film resist, 10 micrometers (this is core extent of quartz single mode fiber) - 1000 micrometers (this is core extent of the plastics fiber (POF) by the acrylic ingredient) are at best still more desirable, and a 50 to about 500 micrometers thing is used suitably. As size of optical guided wave objects, such as a fiber, it is applicable in any sizes from about 125 micrometers to about 1mm. Since a thick-film ingredient thru/or a thick-film resist perform a process at a phot usual lithography processes, it can perform simply doubling a guide hole center

position with a two-dimensional light corpuscle child with a sufficient precision. Therefore, the process which carries out alignment of the structure in which the guide hole was formed, and is pasted up can be skipped.

[0014] The controllability of a bore diameter and configuration control are also excellent from the property of a thick-film ingredient thru/or a thick-film resist, and a process becomes easy compared with the approach of making a hole by substrate etching.

[0015] About a two-dimensional light corpuscle child, a surface emission-type laser, a two-dimensional photo detector, etc. are used, after mounting the component of a chip size required for a mounting substrate, and the number of arrays, it is removing a growth substrate and making it a thin film mold, and a mounting substrate can also be used as a handling substrate. Thereby, the yield which can be taken from a two-dimensional light corpuscle child's wafer can increase and low-cost-ize.

[0016] Said two-dimensional light corpuscle child is formed into two or more arrays, and corresponds to it. Moreover, also array-ize both guide holes, and they are formed, or Only a two-dimensional light emitting device is the combination of a two-dimensional photo detector or a two-dimensional light emitting device, and a two-dimensional photo detector, or said two or more two-dimensional light corpuscle children Said two-dimensional light corpuscle child is the surface emission-type laser of a perpendicular resonator mold, or a surface emission-type laser About a growth substrate, it thin-film-izes, and it is what the stratum functionale of only a barrier layer, a resonator layer, and a Bragg reflection mirror layer is left behind, or said two-dimensional light corpuscle child is [and] removal or a thing to which the growth substrate is left behind as it is. [that it is a thin film mold]

[0017] About the distance of optical guided wave object end faces, such as a fiber, and a two-dimensional light corpuscle child, if a thick-film ingredient thru/or a thick-film resist are made two-layer and distance is controlled by the thickness of the 1st layer, a controllability and a degree of freedom can be raised. That is, said thick-film ingredient or a thick-film resist consists of the 1st layer in which the hole which can penetrate only light smaller than the size of said optical guided wave object was formed, and the 2nd layer in which the guide hole for being formed on this 1st layer and fixing this optical guided wave object was formed, and can specify the distance of the end face of said two-dimensional light corpuscle child and this optical guided wave object by the thickness of the 1st layer.

[0018] Also about the configuration of an optical guided wave object guide hole, it is dependent on the design of a photo mask, and can set up freely, and it is also possible to design so that the recess of the adhesives for immobilization may be made or an optical guided wave object and a guide hole may tend to fit in (for example, for a guide hole to be made into the shape of a taper). That is, the guide hole formed by said thick-film ingredient or the thick-film resist forms only the part doubled with the appearance of this optical guided wave object, and change, or also form a slot pattern which is different from that appearance with the part doubled with the appearance of this optical guided wave object, and change, or the part and the slot pattern which have been set by the appearance of the optical guided wave object of said guide hole in this case are formed continuously.

[0019] Furthermore, it has electrical installation and the above-mentioned two-dimensional light corpuscle child is mounted in a mounting substrate so that it can drive, and the two-dimensional light corpuscle child mounting object of this invention is characterized by fixing an optical guided wave object to said guide hole, and growing into it.

[0020] Said mounting substrate is a mounting substrate which can accumulate other light corpuscle children or electronic devices on a hybrid, and has a heat sink function.

[0021] Said two-dimensional light corpuscle child is formed into two or more arrays, and can also array-ize an optical guided wave object to coincidence. Said optical guided wave object consists of optical fibers containing a polymer, or consists of optical fibers containing a quartz.

[0022] Furthermore, the approach of producing the above-mentioned two-dimensional light corpuscle child mounting object of this invention The process and at least one two-dimensional light corpuscle child who form a circuit pattern in a wafer-like mounting substrate serially The process mounted in two

or more places of a mounting substrate, the process which forms a guide hole with a thick-film ingredient on each two-dimensional light corpuscle child, After carrying out flip chip mounting of the required electron device etc. serially in a required location, it is characterized by including the process started on the mounting object of required magnitude, and the process which fits an optical guided wave object over a guide hole, and is fixed at the last. [two or more]
[0023] Furthermore, the optical wiring equipment of this invention is mounted in the board in electronic equipment through a connection lead. Are optical wiring equipment which delivers and receives the signal between boards with light, and the electronic circuitry for a two-dimensional light corpuscle child drive is also integrated on the above-mentioned two-dimensional light corpuscle child mounting object. It is characterized by carrying out surface mounting of this optical mounting object to the plinth which fixes the connection lead for acquiring electric contact, and constituting the optical connection module, or It is characterized by mounting the above-mentioned two-dimensional light corpuscle child mounting object on the electronic circuitry for a two-dimensional light corpuscle child drive, storing in an electrical connector, and for the contact pin for connectors in which desorption is possible performing electrical connection from this electronic circuitry for a drive, and delivering and receiving an electronic equipment comrade's signal with light.
[0024] Thus, the optical mounting object which combined the two-dimensional light corpuscle child and the optical guided wave object using the thick-film resist thru/or the thick-film ingredient can be made to be able to integrate with an electronic circuitry, and it can use as optical interconnection equipment equipped with transmission and reception. In that case, it can use for optical wiring between electronic circuit boards, the optical connection between electronic equipment, etc., and the mass high-speed transmission of many channels is realizable [stopping an electromagnetic radiation noise] by 1Gbps or more per 1ch with low cost.
[0025]
[Embodiment of the Invention] A drawing is used for below and the example of this invention explains the gestalt of implementation of invention to it.
[0026] (The 1st example) The 1st example by this invention is shown in drawing 1 which is a perspective view. Bonding of the surface emission-type laser 5 array-ized by four is carried out to the mounting substrate 1 through the common electrode 2 in 750-micrometer pitch. The isolation slot of each component 5 is shown by 8, and the part equivalent to the point emitting light is shown by 6. As for the electric wiring for driving a surface emission-type laser 5, the wiring 10 for common electrodes and the wiring 9 for an independent drive are formed on the mounting substrate 1. The independent electrode 25 for a surface emission-type laser drive is connected with wiring 9. Moreover, flip chip mounting of the driver IC 12 for a surface emission-type laser drive is carried out on the same mounting substrate 1. A driver IC 12 is connected to other electron devices etc. by wiring 13.
[0027] As an optical fiber inserted in the guide hole 4, the plastic optical fiber (POF) 16 of the diameter of 500 micrometer is used. POF16 is sandwiched with a fixture 14 and the flat fixture 15 with the V groove formed by plastic mold, and is being fixed by adhesives 17. This V groove can perform now alignment of the pitch of POF16, and a center position. The tip of POF16 has a form which projected as shown in drawing 1 rather than the field formed with fixtures 14 and 15, and set the amount of ejection to 500 micrometers in this example. Four POF(s)16 carry out package cutting with a knife, after carrying out adhesion immobilization using fixtures 14 and 15, and polish carries out flattening of the end face. From it being POF16, flattening may be forced on the heated flat side and may be performed. Moreover, while making it a suitable curved-surface configuration and preventing reflection, you may make it the lens effectiveness arise.
[0028] Although POF16 used by this example considered as the fiber (Asahi glass, trade name RUKINA) using all the fluorination polymers that can transmit even 1.3-micrometer band, as for a limit, neither the thing using a deuteration polymer nor the thing using UV hardening resin is in an ingredient. Moreover, what is necessary is for what used the core as the quartz, and the fiber which consisted of quartzes

altogether to be also easy to be natural, and just to design the configuration of the path of the guide hole 4, or the V groove of a fixture 14 according to the diameter of a fiber.
[0029] On the other hand, the guide hole 4 for optical fibers used as the description of this invention is formed by the thick-film resist 3 so that the core of each point 6 of a surface emission-type laser 5 emitting light may be in agreement with the core core of an optical fiber 16. In drawing 1 , it is considering as the fluoroscopy perspective view so that intelligibly. Pattern formation of this thick-film resist 3 is carried out by applying by a direct spin coater etc. on the mounting substrate 1, and performing phot lithography. Pattern doubling can make the core of the point 6 emitting light, and the core of the guide hole 4 in agreement in the location precision of several micrometers or less, if the mark doubled with the electrode 25 formed in the front face of a surface emission-type laser 5 is formed on the photo mask.
[0030] In this example, SU 8-50 of MicroChem was used as a thick-film resist 3. It applied by the thickness of 200 micrometers with the spin coat, and prebaked at 90 degrees C on the hot plate. It exposed by the aligner, performing the above pattern doubling in 3mmx1mm outer frame size, using a photo mask so that it may have a 520-micrometer circular pattern in 750-micrometer pitch. Next, after performing BEKU after exposure at 90 degrees C on a hot plate again, the resist was developed with the developer. The rinse after development was performed by isopropyl alcohol, and in order to evaporate a solvent completely, oven performed 90-degree C BEKU. As mentioned above, although SU8 was used here as a thick-film resist 3 which can form the guide hole 4, without doing damage to the light corpuscle child 5, electric contact, etc. since the process of the thick-film resist 3 was performed at low temperature, it is not limited to this.
[0031] After applying a binder to the guide hole 4, optical coupling can be easily attained by inserting POF16 fixed to the fixture. The optical adhesives of thermosetting or ultraviolet-rays hardenability were used for the binder with the ingredient which brought the refractive index close to POF16. When giving the lens effectiveness by the fiber end face, the ingredient with which refractive indexes differ may be used. Moreover, in order to suppress reflection, nonreflective coating (un-illustrating) may be carried out to a surface emission-type laser outgoing radiation side by SiOx etc.
[0032] Next, the bond part of a surface emission-type laser 5 and POF16 is explained using drawing 2 (A-A' cross section of drawing 4 R> 4) which is the sectional view of one component.
[0033] Although the detail of the surface emission-type laser 5 used by this example is explained later, it removes a growth substrate so that it may be easy to perform the process of the thick-film resist 3, and makes it the structure which imprinted and thin-film-ized only the stratum functionale. The stratum functionale has structure which sandwiched the one-wave resonator 23 containing a barrier layer by the p-DBR mirror 22 and the n-DBR mirror 24 which consist of AlGaAs multilayers, and thickness is about 7 micrometers. The air post 28 for a current constriction is processed into the p-DBR mirror 22 side circularly [15 micrometerphi], and flattening of the surroundings is embedded and carried out with polyimide 27. Near the barrier layer, steam oxidization only of the 0.95 or more AlGaAs layers is alternatively carried out in a longitudinal direction, and aluminum mole fraction has formed the AlxOy layer 29, makes aperture size of a current impregnation field 3 micrometerphi extent, and is setting the oscillation threshold to 1mA or less.
[0034] The common electrode 20 was formed in the p-DBR mirror 22 side, and it has pasted up with AuSn solder etc. on the electrode pad 2 of substrate 1 front face. Au comrade's sticking by pressure is sufficient as adhesion. The electrode 25 by the side of n forms the GaAs substrate (un-illustrating) of n-DBR mirror 24 front face on the front face which removed and appeared so that current impregnation can be carried out independently of each component. He is trying to take contact to the wiring 9 which forms an insulator layer 26 in this front face, forms the optical takeoff connection 31 and a contact hole 32, and is formed in the front face of a substrate 1. In addition, in order for the side attachment wall of a surface emission-type laser 5 to also mind and carry out the stage conduct-of-business line of the wiring 9, the side-attachment-wall [of laser 5] and common electrode pad 2 top by the side of p needs

to be covered by the insulator layer 26. Photosensitive polyimide like for example, Asahi Chemical PIMEL was suitably used for such insulator layer formation, and thickness was set to 1 micrometer.
[0035] POF16 is fixed like drawing 2 in the location (this example wiring 9 on an electrode 25) where an end face runs against a component front face. Therefore, the crystal front face of a surface emission-type laser is not hit directly, and a damage etc. is not given.
[0036] He is trying for the heat generated from a surface emission-type laser to radiate heat to the mounting substrate 1 through the electrode pad 2 on the other hand. Therefore, as the quality of the material of the mounting substrate 1, AlN or Si in which insulating thin films, such as aluminum203, were formed on the front face is used suitably.
[0037] Next, the making process of the surface emission-type laser of the thin film mold used for this example with reference to drawing 3 is explained. Here, the array of two components explains for simplification.
[0038] In (a), crystal growth of the one-wave resonator layer 23 which consists of AlGaAs on the n-GaAs substrate 30 including the barrier layer which consists of the n-DBR mirror 24 and three quantum wells of GaAs/AlGaAs, the p-DBR mirror 22, and the p-GaAs contact layer (un-illustrating) is carried out by metal-organic chemical vapor deposition etc. The air post 28 is formed by reactant etching using Cl2, and the already described selective oxidation layer 29 is formed by oxidation by the steam. Then, an insulator layer is formed by the SiNx film 21, polyimide 27 performs flattening, and the common electrode 20 is formed. Ti/Au can be used as a common electrode 20.
[0039] In (b), after setting to about 100 micrometers the component on the wafer produced by (a) by polish of a substrate 30, it starts in suitable magnitude, and on the electrode pad 2 formed on the mounting substrate 1, it is sticking by pressure (you may assist ultrasonically) of Au-Au, or pastes up with AuSn solder. At this time, the electrode pad 2 consists of Ti/Pt/Au and the maximum front face serves as Au.
[0040] In (c), the GaAs substrate 30 is etched using the mixed liquor of H2O2 and NH3, and etching stops by AlAs which is the 1st layer of the n-DBR mirror 24. Then, the independent electrode 25 is formed on the n-GaAs layer which removed A1As and appeared by HCl. AuGe/nickel/Au can be used for the independent electrode 25. Then, annealing is performed at about 380 degrees C for contact.
[0041] The whole is coated with polyimide 26 in (d), forming the hole 32 and the optical ejection aperture 31 for electrode contact with photosensitive polyimide. If wiring 9 is formed by the lift-off method etc. by Ti/Au etc., it will be in the condition that the thin film mold face luminescence laser 5 was formed on the mounting substrate 1 as shown in the top view of drawing 4 .
[0042] Above, although the making process about one chip was described, the process of wafer level is needed in fact for improvement in productivity. The thing explaining the situation is drawing 5 . From the GaAs wafer 50 with which the surface emission-type laser was produced, the laser chip 51 (the above-mentioned example 1x4 arrays) of required magnitude is cut down, and the Si wafer 52 which formed two or more 2Oaluminum3 film and electrode pads 2 in the front face to the required field 54 is pasted. At this time, bonding is performed serially, carrying out alignment to the required location 54 on a wafer 52 with flip chip bonder equipment. Formation of the fiber guide hole 4 by the thin film-ized process, wiring process, and the thick-film resist 3 of laser is put in block in this condition, and is performed at phot lithography and an etching process.
[0043] Next, bonding of Si-IC53 for a laser drive is serially carried out by flip chip HONDA. Finally, if dicing is carried out to each chip like a broken line 55, two or more chips can be formed collectively.
[0044] In addition, although the example so far has shown the example which set the surface emission-type laser 5 and the number of arrays of an optical fiber 16 to four, of course, there is no limitation in this number. Four or more are sufficient and what was used only as one surface emission-type laser and one optical fiber may be used. Moreover, it is also applicable to a two-dimensional photo detector.
[0045] Any are sufficient although considered as that on which only the surface emission-type laser was accumulated in the transmitting side as an optical mounting object, the thing on which only the two-

dimensional photo detector was accumulated in the receiving side, or the optical mounting object equipped with both transmission and reception. Bidirectional transmission will be attained, if it becomes one direction transmission and another side and a transceiver device are stored in one module, when the transmitting device and the receiving device are divided.

[0046] (The 2nd example) The 2nd example of this invention is involved in the example using not the surface emission-type laser of a thin film mold that removed the GaAs substrate but the usual surface emission-type laser produced on the GaAs substrate. The cross-section structure of a surface emission-type laser is almost the same as what is shown in drawing 3 (a) explaining a process of drawing, and the place which carries out electrode separation between components differs from the structure of the electrode by the side of p having prepared the aperture for optical ejection.

[0047] The perspective view of this example is shown in drawing 8 . It is almost the same as the configuration of drawing 1 except having performed wiring 81 of that the logging size of a surface emission-type laser 84 became large, laser 84, and IC12 by wirebonding, and explanation of the same part is omitted.

[0048] In the front face of the surface emission-type laser 84 produced on the GaAs substrate, Ti/Au82 used as p electrode-cum-electric wiring and an electrode pad is formed on the insulator layer. The optical ejection aperture is formed in the point 83 of the p electrode emitting light at considerable, then the time. Between the electrode pad 80 on the mounting substrate 1 electrically joined to IC12, and the p electrode 82, it wires by wirebonding 81. This wiring may use a flexible patchboard etc.

[0049] After the thick-film resist 3 which constitutes the fiber guide hole 4 forms a surface emission-type laser and p electrode on a GaAs substrate, before starting it for a chip, it is put in block and formed on a front face. Therefore, there are no processes, such as phot lithography, after mounting the chip of a surface emission-type laser 84 on the mounting substrate 1, and they only have wiring by the surface mount by the package reflow (heating of solder), wirebonding, etc.

[0050] In this example, since the chip logging size from a GaAs wafer is larger than the 1st example, it decreases, the number, i.e., the yield, of laser obtained from a laser wafer, and the cost of a mounting object goes up. moreover, a cathode -- since it drives as common, compared with an anode common type like the 1st example, it is inferior to the rapidity of a drive.

[0051] However, with the structure in this example, since a process process decreases and reduction of production cost and improvement in the yield are attained, when the number of arrays is transmission which is 622Mbps extent few, it is suitable.

[0052] (The 3rd example) In the 3rd example by this invention, a thick-film resist is made a two-step configuration, and the distance of the outgoing radiation side of a surface emission-type laser and a fiber end face is specified. This is explained using drawing 6 .

[0053] The thick-film resist 60 which formed the fiber guide hole 63 by the thick-film resist 61 of a two-layer eye, and formed the hole 62 of 300 micrometerphi thinner than the path of a fiber 16 is the 1st layer. This can constitute the same thick-film regist patterning process as the 1st example from repeating twice. In this case, any resist thickness was set to 200 micrometers. when it dashes, comes out of and mounts a fiber 16 in the guide hole 63 by this, it can make it ease to collide with a laser component etc. and to give a damage Moreover, although it is desirable to make optical coupling with a fiber 16 condense with a lens, this can be attained by putting a ball lens etc. into the hole of the thick-film resist 60 of the 1st layer. Especially, in association with a photo detector and a fiber 16, it is effective.

[0054] Moreover, by this approach, the distance of a fiber end face and a surface emission-type laser end face can be freely set up by controlling the thickness of the thick-film resist 60 of an eye further.

[0055] (The 4th example) The top view of the pattern of the thick-film resist 70 of the 4th example of this invention is shown in drawing 7 . The slot 71 other than the guide hole 72 which mounts a fiber is formed.

[0056] By forming this slot 71, there is an operation as recess of the effectiveness which brings forward

the developing time of the thick-film resist 70, the effectiveness of relaxation of stress with a substrate, and the adhesives for immobilization etc. Furthermore, there is also an advantage of being easy to fit in when putting a fiber into the guide hole 72.

[0057] In the case of the approach of forming a fiber guide hole using a thick-film resist, a pattern configuration can be freely designed by changing the pattern of a photo mask in this way. For example, the things (1mmphi, 500micrometerphi, 250micrometerphi, etc.) from which the diameter of a fiber differs can be made to be able to integrate, or a guide slot which fits in the waveguide film of rectangles other than a fiber etc. similarly can be formed, and a waveguide film etc. can also be fixed here.

[0058] (The 5th example) The 5th example by this invention is related with the high-speed light wiring equipment which carried out the modularization of the optical mounting object described above, and was able to do it.

[0059] Drawing 9 shows the connector module using the mounting object with which the surface emission-type laser, the two-dimensional photo detector, and the fiber were fixed by the guide hole by thick-film resist like the 1st, 2nd, and 3rd example. In drawing 9 (a), 94 is the ribbon fiber which bundled four fibers, POF and 96 cover the fixture for POF immobilization, 93 covers the whole, and 95 strengthens the fixed reinforcement of POF95. Moreover, although 92 is the mounting substrate 1 shown by drawing 1 , a circumference circuit is also formed in coincidence and the chip resistor and the capacitor are also integrated. Furthermore, 90 is a plinth which fixes the lead 91 for connection, pasted up with the rear face of the mounting substrate 92, and has connected the electrode pad of the mounting substrate 92, and the top of lead 91 by wirebonding. After the immobilization between a fiber 95 and the mounting substrate 92 performs wirebonding, it is performed at the end. Connection of the lead 91 for connection and the mounting substrate 92 may form a through hole in the mounting substrate 92, and may be performed by flip chip mounting.

[0060] On the other hand, the mounting gestalt of this connector module and circuit board 97 is shown in drawing 9 (b) and (c). In (b), the socket 98 is fixed with lead 102 and solder 10 on a substrate 97, contact is acquired by the connection lead 91 of a connector module, and the flat spring 99 of a socket 98, and desorption is possible. In (c), the connection lead 91 is directly soldered to the circuit board 97 (103).

[0061] By making it such a configuration, the optical wiring equipment in the case of transmitting a high speed signal between boards can be offered. It becomes effective when an electromagnetic radiation noise becomes a problem, a case so that 1Gbps per 1ch may be exceeded, and.

[0062] Although it will fix to the circuit board 97 in drawing 9 (c), between the mounting substrate 92 and the fiber fixtures 93 is not pasted up, but it is good even if desorption is possible for the guide hole of the thick-film resist 100 by the way. In that case, what is necessary is to prepare a pawl etc. in the outer frame of the fiber fixture 93, and just to form the machine device in which desorption is possible. In addition, 101 is covering.

[0063] (The 6th example) The 6th example by this invention does not equip a direct mother board with the optical transceiver module with which the optical mounting object was accumulated like the 5th example, but as shown in drawing 10 , it stores it in an electrical connector 110, and through the electrical connection lead 111, the interface section and desorption of electronic equipment, such as PC, a monitor, a printer, a digital camera, and a digital camcorder, are possible for it, and it is made. This electrical connector 110 is producible according to the specification of a required device. For example, it is also possible to make it the MDR connector of 26 in all pins at the specification of the digital monitor interface for connecting a liquid crystal display monitor with PC, or to double with specification, such as IEEE1394 and USB. Moreover, it is applicable to the internal connection of the scanner section of a digital copy machine, and the sensitization section etc. By using the optical wiring equipment of this invention for connection between these electronic equipment, 50m or more of the signal transmission of 4-5 channels becomes possible from 1Gbps per channel at about 2.5Gbps. In this way, in an electrical cable, it can be used instead of high-speed image transmission with a limitation. Moreover, since it is

optical connection, there is no electromagnetic radiation noise generated from the transmission line, and it is especially tied to mitigation of the cure against a noise in high speed digital transmission.

[0064]

[Effect of the Invention] The following effectiveness is expected by this invention. The alignment precision of optical guided wave objects, such as an optical fiber, and a light corpuscle child is raised, immobilization of optical guided wave objects, such as an optical fiber, can be made easy, and it can raise productivity. Moreover, the ease of mounting at the time of performing optical coupling with optical guided wave objects, such as an optical fiber, by lens loess and the degree of freedom of a design can be raised by thin-film-izing a two-dimensional light corpuscle child.

[0065] Furthermore, the optical wiring equipment using the optical mounting object and this in which low-cost-izing is possible is realizable by offering the production approach which can mass-produce the structure with being such for mounting. therefore, the field which has a limitation by electrical connection in signal connection of an electronic equipment comrade between the boards in the electronic equipment handling a high-speed digital signal -- namely, -- an about 2.5Gbps signal transmission is possible at 50m or more -- becoming -- mass image transmission etc. -- easy -- special electromagnetism -- the cure against a noise etc. can be performed nothing.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is a perspective view explaining the two-dimensional light corpuscle child mounting object of the 1st example by this invention.

[Drawing 2] It is the sectional view of the two-dimensional light corpuscle child mounting object in the 1st example by this invention.

[Drawing 3] It is a sectional view explaining the production approach of the two-dimensional light corpuscle child by this invention.

[Drawing 4] It is a top view explaining wiring of the two-dimensional light corpuscle child mounting object by this invention.

[Drawing 5] It is a perspective view explaining the production approach of the two-dimensional light corpuscle child mounting object by this invention.

[Drawing 6] It is the sectional view of the two-dimensional light corpuscle child mounting object of the 3rd example by this invention.

[Drawing 7] It is the top view of the guide hole configuration of the 4th example by this invention.

[Drawing 8] It is a perspective view explaining the two-dimensional light corpuscle child mounting object of the 2nd example by this invention.

[Drawing 9] It is drawing explaining the optical connection module by this invention.

[Drawing 10] It is the perspective view showing the optical wiring equipment by this invention.
[Drawing 11] It is a sectional view explaining association of the conventional two-dimensional light corpuscle child and an optical fiber.
[Drawing 12] It is a sectional view explaining association of the conventional two-dimensional light corpuscle child and an optical fiber.
[Drawing 13] It is drawing explaining association of the conventional two-dimensional light corpuscle child and an optical fiber.
[Description of Notations]
1 -- Mounting substrate
2 80 -- Electrode pad
3, 60, 61, 70,100 -- Thick-film resist
4, 63, 72, 1209 -- Fiber guide hole
5 84 -- Two-dimensional light corpuscle child
6, 31, 62, 83 -- Light transmission aperture
8 -- Isolation slot
9, 10, 13 -- Electric wiring
12 53 -- Si-IC
14, 15, 2014 -- Fiber fixture
16, 95, 1210, 1037, 2016 -- Optical fiber
17 1211 -- Adhesives
20, 25, 1033, 1035 -- Electrode
21, 26, 1208 -- Insulator layer
22, 24, 1023, 1027 -- DBR mirror
23 -- A barrier layer and resonator layer
27 -- Embedding layer
28 -- Air post
29 -- Selective oxidation AlxOy layer
30 1021 -- Substrate
32 -- Contact hole
50 -- Laser wafer
51 -- Laser chip
52 -- Wafer for mounting
54 -- Mounting field
55 -- Perforated line which carries out dicing
71 -- Slot
81 -- Wire
90 -- Plinth for connection lead immobilization
91,111 -- Connection lead
92 -- Optical mounting object
93 96 -- Fiber fixture
94 -- Fiber array
97 -- Circuit board
98 -- Socket
99 -- Flat spring
101 -- Covering
102 -- Contact pin
103 -- Solder
110 -- Electrical connector
1022 -- Light absorption layer

1024 1026 -- Cladding layer
1025 -- Barrier layer
1028 -- Contact layer
1032 -- Si02
1036 -- Antireflection film
1201 -- Electronic-circuitry substrate
1202 -- Luminescence chip
1203 2018 -- Surface emission-type laser
1204 -- Transistor
1205, 1206, 1207 -- Transistor electrode
2012 -- Module substrate
2022 2023 -- Projection
2024 -- Fiber insertion hole
2026 2027 -- Guide hole

[Translation done.]